Invited: Special session organized by S. Cloude on "Polarimetric Effects in Interferometry"

Effect of Medium Symmetries in Limiting the Number of Parameters Estimated with Polarimetric Interferometry

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The addition of interferometric backscattering pairs to the conventional polarimetric SAR data over forests and other vegetated areas increases the dimensionality of the data space, in principle enabling the estimation of a larger number of vegetation parameters. Without regard to the sensitivity of these data to vegetation scattering parameters, this paper poses the question: Will increasing the data channels as such result in a one-to-one increase in the number of parameters that can be estimated, or do vegetation and data properties inherently limit that number otherwise?

In this paper, the complete polarimetric interferometric covariance matrix is considered and various symmetry properties of the scattering medium are used to study whether any of the correlation pairs can be eliminated. The number of independent pairs has direct consequences in their utility in parameter estimation schemes, since the maximum number of parameters that can be estimated cannot exceed the number of unique measurements. The independent components of the polarimetric interferometric SAR (POL/INSAR) data are derived for media with reflection, rotation, and azimuth symmetries, which are often encountered in vegetated surfaces. Similar derivations have been carried out before for simple polarimetry, i.e., zero baseline. This paper extends those to the interferometric case of general nonzero baselines. It is shown that depending on the type of symmetries present, the number of independent available measurements that can be used to estimate medium parameters will vary. In particular, whereas in the general case there are 27 mathematically independent measurements possible from a polarimetric interferometer, this number can be reduced to 15, 9, and 6 if the medium has reflection, rotation, or azimuthal symmetries, respectively. The results can be used in several ways in the interpretation of SAR data and the development of parameter estimation schemes, which will be discussed at the presentation. Recent POL/INSAR data from the JPL AIRSAR over a forested area will be used to demonstrate the results of this derivation.

This work was performed by the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, under contract from the National Aeronautics and Space Administration.